Books of
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for children

Human Body

A richly illustrated exploration
of yourself

Wonder World Series

Books Of Knowledge
For Children

HUMAN BODY

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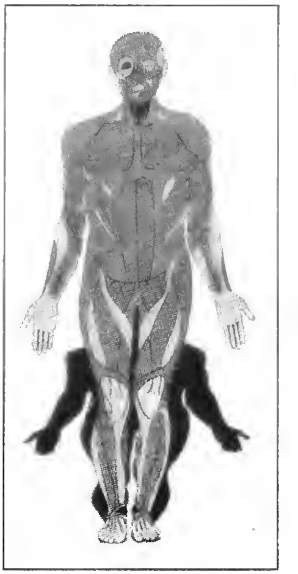
VASAN PUBLICATIONS

1. What is the human body composed of ?

The human body is composed of several chemical elements and other substances. The list below will help you to understand better the proportion of each of the different things our body is made up of.

Class	Chemical Elements or Substances	Body Weight (%)
PURE	OXYGEN	65
ELEMENTS	CARBON	18
	HYDROGEN	10
	NITROGEN	3
	CALCIUM	2
	PHOSPHOROUS	1. 1
	POTASSIUM	0. 35
	SULPHUR	0. 25
	SODIUM	0. 15
	CHLORINE	0. 15
	MAGNESIUM	TRACES
	IRON	,,
	MANGANESE	,,
	COPPER	,,
	IODINE	,,
	COBALT	,,
	ZINC	,,
WATER	WATER	60-80
SOLID MATTER	TOTAL SOLID MATTER	20-40
ORGANIC	PROTEIN	15-20
MOLECULES	LIPID	3-20
	CARBOHYDRATE	1-15
	SMALL ORGANIC	0-1

2. In general how would one describe the human body?



Human body

The human body is made up of a billion cells. A cell is a simple form of life capable of digestion, excretion, respiration, reproduction and other life processes. These cells are organized. In such a way that each cell performs a specialized function.

The human body is like a machine containing several systems for carrying out life's processes. Each system is made up of several organs. These organs are made up of specialized cells and tissues. The nervous system controls the body functions. It consists of mainly the brain, the spinal cord and the nerves. The skeletal system is the framework of our body. It contains more than 200 bones, over half of which are in the hands and feet. The circulatory system supplies the organs and muscles blood which in turn supplies food and oxygen and removes carbon dioxide and other waste products. It consists of the heart, blood and blood vessels.

The other important systems of the human body are the respiratory system which helps us to breathe, the reproductive system which is necessary for the multiplication of the human race, the digestive system, which helps to convert food into a form that can absorbed into the blood and the excretory system which removes the waste materials from our body.

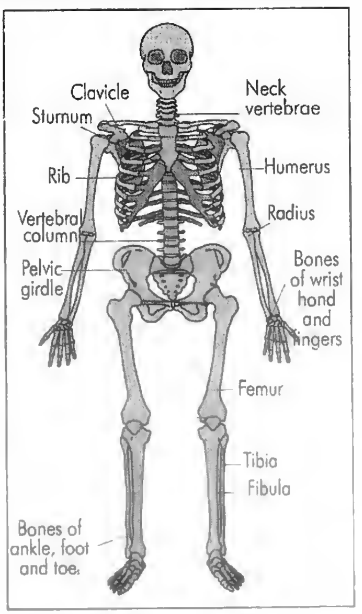
The human body is therefore a marvelous creation, more wonderful than the greatest man made machine. Though it is made up of several different parts they all work as a team.

3. How does the skeletal system form the framework of our body?

Just as a building or a ship has a framework of girders, our body also has a skeleton which forms a framework to give it strength and shape. Without this we would not be able to stand erect and could collapse. The skeleton consists of more than 200 bones. The number varies with age. Children have more bones than adults as with maturity some bones fuse.

The skull is mounted on the spinal column or spine. It consists of 8 bones that are flat and protect the brain. The front part which forms the face has 14 bones of which only the lower jaw is moveable.

The spinal column or the backbone encases the spinal cord, which is a bundle of nerves running from the brain. The spinal column, also known as the vertebral column, consists of a series of bones called the vertebrae. These start from the skull and run down all the way. The backbone, which has 33 bones, also serves to support the body and give it adequate rigidity.



The skeleton

The rib cage protects the lungs and the heart. There are 12 ribs in all. They are long and curved bones. The first 7 are attached to the sternum, or the breastbone, by cartilage. The next 3 are joined to the one above them and the last 2 are free and are therefore called the floating ribs. The ribs are all joined at the back to the spinal column.

The pelvic girdle, or the

hipbone, is the heaviest bone of the body. At the top it is joined to the backbone. At its lower 'end it has two sockets for the lower limbs. The lower limbs are made up of the femur (the thigh bone), tibia and fibula. The bones in the feet are the tarsals, metatarsals, and the phalanges. The forelimbs or the arms consist of the humerus, radius and the ulna. The carpals, metacarpals and the phalanges form the bones of the palm and wrist.

The skeleton serves 4 very important functions. It gives shape, form and support to the body. It protects the delicate parts like the brain and the spinal cord. Organs like the heart, lungs and the kidneys are also protected from injury. The blood cells are made in the bone marrow which is encased inside the bones.

4. How does the blood circulate in our body?

Our body has a wonderful system which transports or circulates our blood. It is known as the circulatory system. It consists mainly of the heart, blood and the tubes called the blood vessels.

The heart is a muscular organ that rhythmically contracts and expands to force blood all over the body. It is conically shaped and is about the size of one's fist. It's walls are thick and powerful and consist of the cardiac muscles. The heart is divided into 4 chambers -

Blood circulation

the left and right auricle and the left and the right ventricle. The auricles are placed above the ventricles. Both the left chambers contain oxygen-rich blood while the right chambers contain blood with carbon dioxide. The blood of both the chambers do not mix as there is a thick wall, called the septum, dividing the two sides.

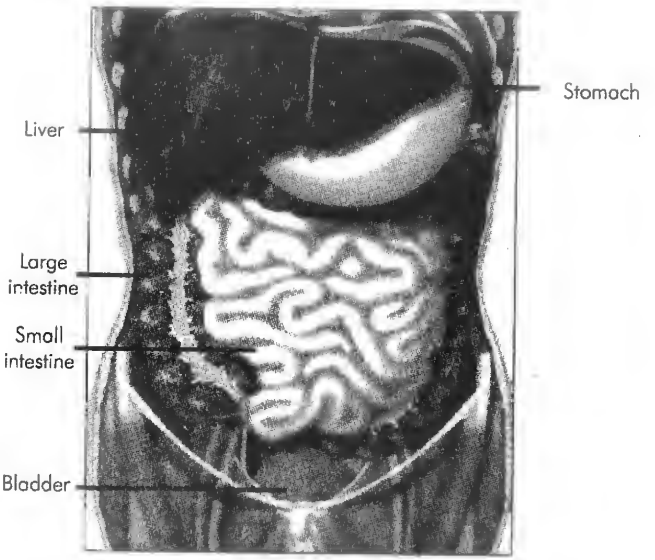
The blood is composed of a transparent and colourless liquid called the plasma in which the blood cells are suspended. The red blood corpuscles form nearly half the volume of the blood. The red colour is caused by the haemoglobin. The white blood corpuscles are of various kinds. Some of them protect the body from attacking bacteria while others produce antibodies to help the body to build its immunity. There are still others that repair the injured tissues. The blood platelets assist in the clotting of the blood when we are hurt or injured. The blood cells are being constantly replaced by new ones from the bone marrow.

There are 3 main blood vessels. The arteries carry the oxygenated blood from the heart to the rest of the body. It is further subdivided into the smaller arteries. These lead to the capillaries which take the blood with its oxygen and nutrients to the cells. From there they lead to the venules and then to the bigger veins which take the now deoxygenated blood back to the heart. This blood now contains carbon dioxide and the heart pumps it back to the lungs. The lungs once again sends oxygen rich blood to the heart.

The largest artery, the aorta, carries the oxygen-rich blood from the left ventricle to the rest of the body. The superior and inferior venae cavae collect the deoxygenated blood from the different parts of the body and bring it to the right auricle. The pulmonary artery carries the blood from the right ventricle to the lungs, while the pulmonary veins bring it back to the left auricle. Thus the circulatory system provides a vital link between the many systems of the body.

5. How is the food digested in our body?

The food that we eat has to undergo a physical and chemical process to be able to be absorbed into the blood which then carries it to the different parts of the body. The human body has a very effective digestive system which processes the food. The digestive tract is about 8 metres long and extends from the mouth to the anus.



The digestive system

The process of digestion begins in the mouth. As we chew our food the teeth grinds them into small pieces. The saliva in our mouth contains mucus and an enzyme called ptyalin or amylase. The mucus helps in swallowing the food while the ptyalin converts the sugar in the food to a complex form called maltose. The tongue pushes the food down into the pharynx which leads into the gullet or the oesophagus. The epiglottis closes the entrance to the windpipe in order to prevent food from entering it. The muscles

of the oesophagus contract and expand thus pushing the food down to the stomach.

The stomach contains gastric juices which are made up of hydrochloric acid, mucus and some enzymes One of the important enzymes is known as pepsin. The muscles of the stomach help to churn and mix the food with gastric juices. The hydrochloric acid makes the food acidic in order to help the pepsin to work on it. It also partially breaks down the starches and kills the bacteria in the food. The mucus protects the stomach lining from being destroyed by the action of the pepsin and the hydrochloric acid. The enzyme, pepsin, partially digests the proteins and converts them into simpler compounds called peptones. The liquidised acidic food is then sent to the small intestine.

In the duodenum, which is a short length of the digestive tract between the stomach and the small intestine, the food is neutralized by the bile. This is a brownish alkaline fluid produced by the liver. It is intermittently released into the duodenum. The bile contains bile salts which assist in the breaking down and absorption of fats. The pancreas, a gland located close to the duodenum, releases enzymes that digest starches, proteins and fats.

The process of digestion is finally completed in the small intestine. The end products are glucose, fatty acids, glycerol and amino acids mixed with water, mineral salts and vitamins. These are absorbed into the blood by the process of diffusion. The undigested food, with no nutritive value, is then passed to the large intestine. Here the water content is absorbed into the walls and the solids pass on to the anus for egestion.

Thus we see that insoluble and complex foods are converted into simple and soluble foods that can be absorbed into the blood without any difficulty.

6. What are the different stages involved in respiration?

All living things have to breathe to survive and each species has its own peculiar way. Some breathe with lungs while others with gills or through the skin. The respiratory system in man is highly developed and consists mainly of the respiratory passage and the lungs.

The air enters through the nostrils. The hair present in it traps the dust to prevent it from coming into the body. The nasal chambers warm the air. These chambers, which are separated from the mouth by the palate, open into the pharynx. Here the respiratory and digestive tracts cross each other - the trachea in the front and the oesophagus behind. The beginning of the trachea is enlarged to form the larynx (the voice box). This contains the vocal cords. The vibrations of these produce sound. A flap of skin, known as the epiglottis, covers the entrance to the larynx when we eat, so that food does not enter it. That is why talking while eating is discouraged as a person can choke.

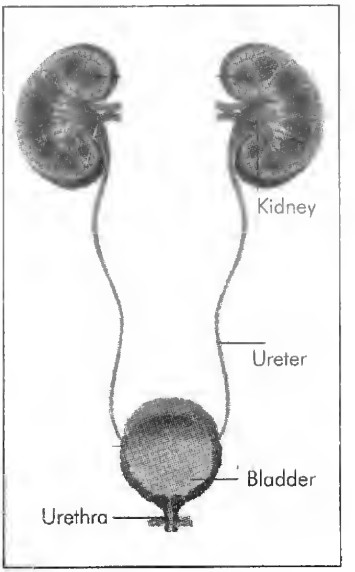
At the lower end the trachea divides into two tubes known as bronchi (singular is bronchus). Each bronchus then enters a lung. Inside the lung the bronchi divide repeatedly forming small tubes called bronchioles. These end in tiny air sacs called alveoli. They form small clusters with a rich network of capillaries.

When we inhale in air through our nose it is known as inspiration. This air is oxygen rich and is circulated throughout our body by the blood. The oxygen helps to break down the absorbed food in the body and as a result releases energy. In this process of oxidation, carbon dioxide, water and heat are formed. In expiration, when we exhale air the carbon dioxide is released.

Increased rate of activity leads to a greater demand for oxygen by the body and this results in a higher rate of breathing. The rate of breathing goes lower as we grow older. For instance, a baby breathes at a rate of about 60 times in a minute, a 13 year old child about 20 times in a minute and an adult about 15 times. An old person even less.

7. How does the body excrete the waste products?

Metabolic activities are continuously taking place inside our body. These chemical reactions result in the formation of several waste products. If these are allowed to stay in the cells they will interfere with their normal functioning and may eventually even kill them. Excretion is therefore the elimination of these waste products. The waste that is formed in the cells diffuse into the lymph and the blood which then transport them to the different organs of excretion.



Excretory system

In man the main organs of excretion are the kidneys, the skin and the lungs. The skin has long tubes known as sweat glands. Their function is to remove the salts and nitrogenous wastes dissolved in a larger proportion of water. This is known as perspiration. This process also helps to cool the body. Though the sweat glands are scattered all over the body, they are more numerous in certain parts like the forehead and the armpits. Men have more sweat glands than women.

The lungs are another organ of excretion. They help remove the carbon dioxide that is formed in our body. Together with this a little amount of water vapour is also released.

The kidneys are the most important excretory organs. They are a pair of reddish-brown organs situated at the back of the abdominal cavity, one on each side of the vertebral column. They are bean-shaped and measure about 11 cm in length, 6 cm in breadth and 3 cm in thickness. Connected to each kidney are the blood vessels - the renal artery and the renal vein. The former

brings in the oxygenated blood while the latter removes the blood after it has circulated in the kidney. There is a third tube leading from the kidney. This is the ureter which is connected to the urinary bladder in the lower part of the abdominal cavity. The urine produced in the kidneys is carried by the ureter and stored in the urinary bladder until it is passed out through another tube called the urethra.

Urine is a mixture of several organic and inorganic matter. About 96% of urine is water. The rest consist of urea, creatinine, uric acid, chlorides and phosphates of sodium and potassium. All these metabolic wastes produced in the cells are brought by the circulating blood to the kidneys and then excreted in the form of urine.

The excretory organs thus efficiently remove the metabolic wastes from our body which would other wise prove toxic and harmful to us. They are essential to the healthy functioning of the cells in the body.

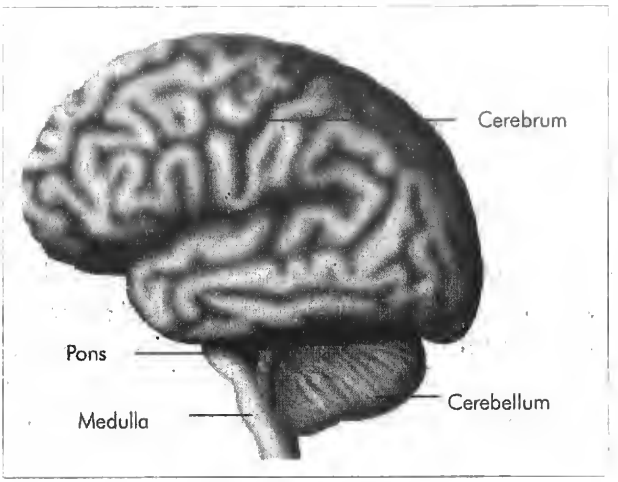
8. How does the central nervous system control the working of the human body?

Though there are several systems in the human body they cannot function on their own. They are coordinated and controlled by the nervous system. The human race has been endowed by a highly developed nervous system. This has resulted in the human race being positioned on top of the animal world.

The nervous system consists of chiefly the brain, the spinal cord and the nerves. The structural and functional units of this system are the neurons or the nerve cells. There are about 13 billion nerve cells in the human body of which 10 billion are in the brain itself. They form a complex and elaborate network that helps to keep every part of the body connected to the brain. There are two parts to the nervous system - the central nervous system and the peripheral nervous system.

The central nervous system consists of the brain and the spinal cord. The brain weighs roughly 1. 4 kg and has a volume of about 1500 cu cm. It is covered by a soft membrane called the meninges and is further protected by the cranium, the dome shaped area of the skull. The brain is divided into four sections : the cerebrum, the cerebellum, the pons and the medulla.

The cerebrum is the largest part of the brain and consists of at least two-thirds of it. It is divided into the right and left cerebral hemispheres. The outer surface of the cerebrum is covered by greyish matter called the cerebral cortex. It contains about 2500 million nerve cells. Below this lies the white matter which is a bundle of nerve fibres. It connects the different parts of the cerebrum as well as connecting the cerebrum to the other parts of the brain. The cerebrum is the seat of consciousness, intelligence, memory, imagination and reasoning. It initiates all voluntary activities. There are specific areas for hearing, seeing, tasting, speaking and so on. That is why if a certain part of the brain is injured the person is unable to carry out the functions associated with that part of the brain.



The human brain

The cerebellum lies below and behind the cerebrum and is the second largest part of the brain. This too has grey matter on the outside and white matter inside. It regulates and coordinates

the group movements of muscles as in actions like walking and running.

The pons is a bridge of nerve fibres that connect the lobes of the cerebellum. They coordinate the movement of muscles on both sides of the body.

The medulla oblongata merges the rest of the brain to the spinal cord. This is where the nerve fibres that go from the brain to the spinal cord cross. The nerve fibres from the left cerebral hemisphere cross over to the right and control that part of the body. Likewise the nerves of the right cerebral hemisphere cross over to the left and control that part of the body. The medulla controls the heart, breathing and digestion.

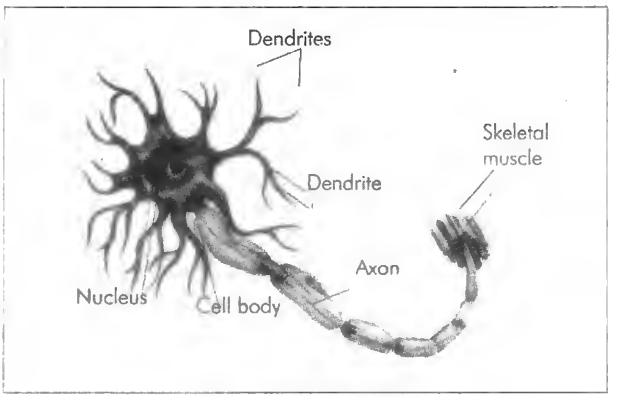
The second part of the central nervous system is the spinal cord which is a soft curved cylinder. It is protected by the spinal column and runs all the way from the brain down the back. It is also covered by the same meninges that protects the brain. The spinal cord is made up of nerve cells. The nerves carry messages to and from the brain to other parts of the body and acts as a reflex centre. From the spinal cord 31 pairs of nerves branch out into the body. These nerves together with 12 pairs of cranial nerves form the peripheral nervous system.

Thus we see that the nervous system controls and coordinates the functioning of the different parts of the body. With the help of the various sense organs, the central nervous system interprets the environment and responds suitably to changes in it.

9. What is the peripheral nervous system?

The human body has an extremely developed nervous system. This has contributed greatly to the survival and civilization of the human beings and their ability to stay far ahead from the other animals in the race of life. The nervous system in man is divided into two sections - the central nervous system and the peripheral nervous system. The former consists of the brain and the spinal

cord. The latter consists of the cranial and spinal nerves and the autonomic nervous system.



Neurons

As the name suggests, the cranial nerves arise from the brain, while the spinal nerves are those that emerge from the spinal cord. A nerve is a collection of nerve cells which are enclosed in a sheath of connective tissue and transmit nerve impulses to and from the brain and the spinal cord. A nerve cell or neuron, is the basic functional unit of the nervous system. Each cell has a nucleus, from which trail processes called dendrites responsible for receiving incoming signals. The unit of information is the nerve impulse. This is a travelling wave of chemical and electrical changes involving the membrane of the nerve cell. The cell's longest process, the axon, carries impulses away from the body. When a person decides to pick up a book the decision is made in the brain but the action is done by the muscles of the hand and the fingers. How does the message of the brain reach the muscles ? This is transmitted as a nerve impulse.

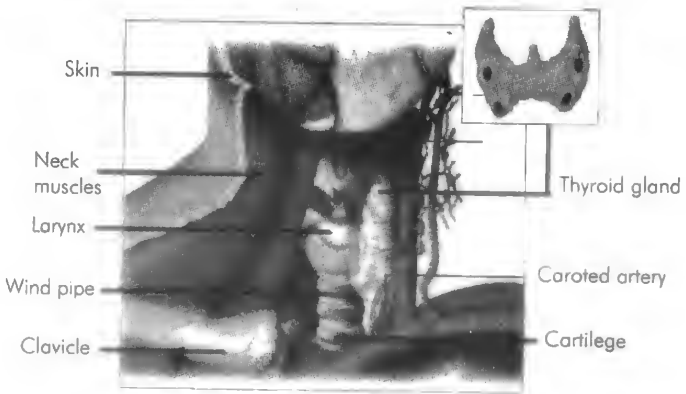
Those neurons that carry an impulse from the sense organ to the central nervous system are called sensory neurons and help us to see, hear, smell, taste, etc. Those that carry an impulse from the central nervous system to the muscles or glands are known as motor neurons and carry out muscle movement and secretion of glands. There are yet others that have both kinds of neurons. These are called mixed nerves.

The autonomic nervous system looks after the routine work

of the organs such as the heart, stomach and intestines. It consists of two kinds of nerves. One set of nerves known as the sympathetic nerves start from two chains of sympathetic ganglia situated on either side of the vertebral column. They supply to the internal organs. These nerves also ready one for quick action, such as fleeing or fighting in an emergency. The other set called the parasympathetic nerves start from the brain and the spinal cord. It retards the acceleration of the stimulation of the sympathetic nerves. Normally a balance is struck between them. The autonomic nervous system thus carries on its work automatically without any conscious control. It is of extreme importance to our daily life and survival.

10. How do hormones coordinate the functions of the body ?

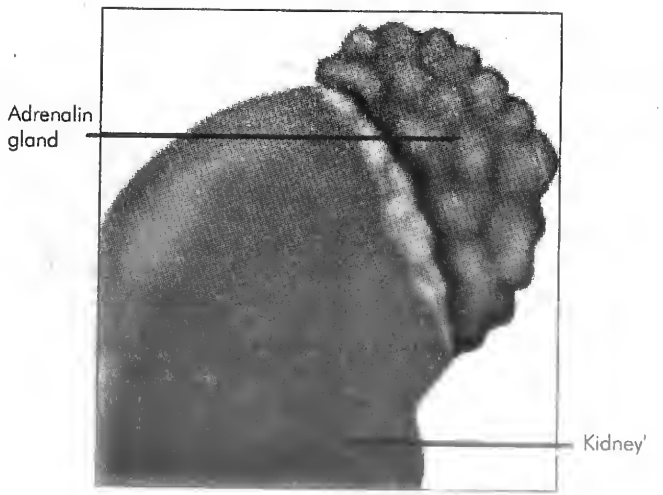
Apart from the nervous system there is another system that helps to coordinate the functions in the body. It is known as the endocrine system. It consists of several glands situated in different parts of the body. They are called endocrine glands or ductless glands. They are distinguished from the exocrine gland, such as the salivary glands or the liver, which have ducts. The secretions of the endocrine glands are known as hormones.



Thyroid gland

There are certain cells in our body that produce chemical substances. These are carried by the blood to some other part of the body where it regulates and coordinates the activities of the cells in that area. In its chemical composition, a hormone may be a protein, or an amino acid, or a steroid. It is produced in very small quantities as even a small amount is very profound in its action. If the glands produce too much or too little, a person may have an abnormal physical appearance. Hormones are continuously eliminated and replaced in the body.

One of the major endocrine glands is the thyroid gland. It is situated in front of the trachea and below the throat. It secretes the hormone called thyroxine, which is an amino acid, in combination with iodine. Thyroxine is essential for normal growth



Adrenal gland

and development, particularly that of the skeletal and nervous systems. Faulty production of this hormone leads to complications like goitre, myxedema and cretinism.

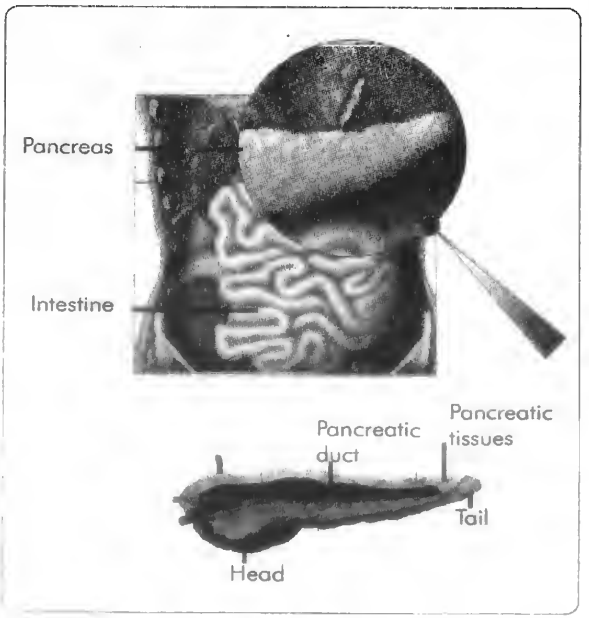
The adrenal glands are a pair of glands situated above each of the kidneys. They produce a hormone known as the adrenalin.

They are not really essential for life but are produced during times of stress like when a person feels terrible fear and wants to flee or fight, both of which need extra energy.

The pancreas is a combination gland. They are both an exocrine gland as well as an endocrine gland. The pancreatic juice required in digestion is carried by the duct to the duodenum. However there are groups of cells which are not connected to any ducts. These are called islet cells and are endocrine in function. The chief hormone secreted by them is insulin, a simple protein. Insulin regulates the carbohydrate metabolism. It removes the excess glucose in the blood and stores it in the form of glycogen in the liver and in the muscles. Insulin deficiency leads to diabetes. Its excess leads to low blood sugar.

The pituitary gland is attached to the hypothalamus of the brain. It secretes several hormones that promotes growth and reabsorption of water from the kidney tubules. Other hormones control the functioning of the other endocrine glands. In fact it is said that the pituitary gland is the captain of the endocrine team.

The parathyroid glands are embedded in the thyroid glands. Its hormone controls the metabolism of calcium. Removal of these



Pancreas

results in death.

The gonads are glands embedded in the testes and ovaries of the male and female respectively. These sex hormones control the growth and development of the secondary sexual characteristics and the sexual behaviour.

Together with the nervous system the endocrine system controls and coordinates the bodily functions. The former enables extremely rapid adaptation to the environment while the latter is somewhat slower.

11. How do we see with our eyes?

Our eyes are one of the most wonderful sense organs of our body. The muscles of the eyes are the most precisely controlled muscles of our body. It is often asked that even though we have two eyes, how come we do not see double. To understand this we should first study the eye structure.

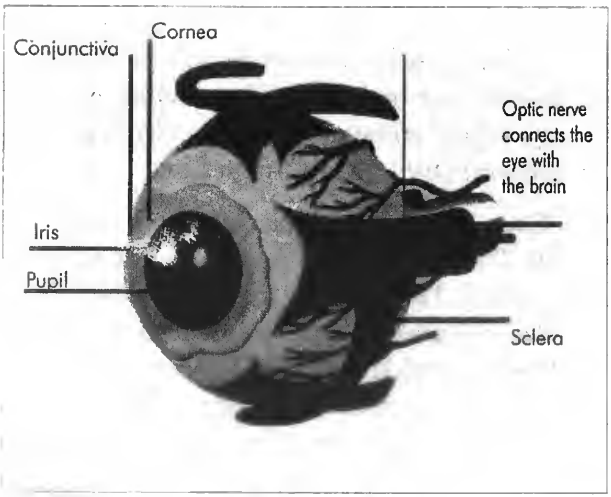
Each eyeball is spherical in shape and is contained in a bony socket. The cornea is the transparent circular part of the front of the eyeball. The pupil is a circular opening in the iris (the flat, circular coloured membrane behind the cornea) Behind the iris lies the lens which is a rounded transparent structure. The ciliary muscles act on the lens to change its shape so that images of objects at different distances can be focussed on the retina. The retina is positioned at the back of the eye. It is packed with light sensitive cells called rods and cones. These are sensory cells that are capable of converting light into nervous messages that pass down the optic nerve to the brain. Between the retina and the lens lie a fluid called the vitreous humor. Similarly between the lens and the pupil lies the fluid called the aqueous humor. The white portion of the eye is the sclera.

The light rays from an object fall on the cornea and pass through the pupil and make an inverted image on the retina. This

image is sent to the brain through the optic nerve. The brain inverts the image and it becomes erect. All this takes place very rapidly. The direction of each of your eyes is controlled by three pairs of muscles. They are controlled by the nerve messages from the brain to keep your eyes pointed together so carefully that the same picture is formed in the two eyes.

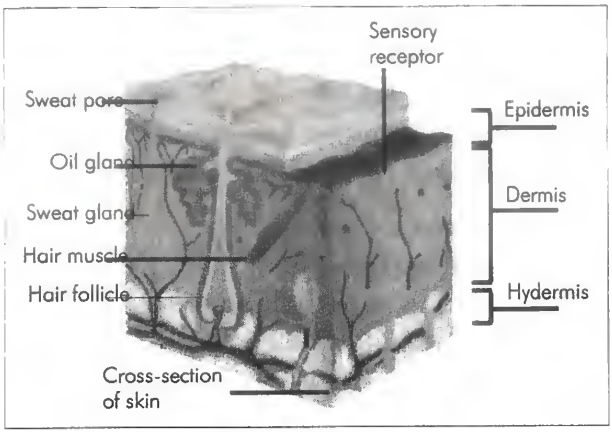
We sometimes notice that the pupils of our eyes change in size. This is done by the iris to protect the pupil. When there is too much of light. The iris muscle contracts to reduce the light entering the pupil. Likewise when there is less light the iris muscle allows more light to enter. The pupil then appears bigger.

Our eyes can differentiate colours very well unlike most animals. The retina has a network of light sensitive cells called rods and cones. There are about 120 million rods in each eye. Rods help us to see in dim light and make out shades of black and white. Cones, on the other hand, help us to distinguish between colours. There are three types of cones, each sensitive to either of the primary colours -red, blue or green. There are about 6 million in each eye. Some people suffer from colour blindness This is due to some abnormality in the cones of the retina. A colour blind person can be blind to one, two or all the three primary colours.



The human eye

12. Which is the biggest organ of the human body ?



The skin

The skin is the biggest organ of the body. It is a surprising fact to most people as very few think of it as an organ in the first place. The skin is the largest organ weighing about 3 kgs for an adult. It is spread out as thinly as possible to form a thin coat. If spread out it would cover an area of 1. 7 sq. metres. The skin forms a protective outer covering around the entire body.

The skin consists of an outer thin portion called the epidermis. The superficial layer of cells are thin, scale-like and dead. They are called the corneous layer of the epidermis. These cells are constantly being replaced by new cells from the layer beneath. The corneous layer is thickened in certain places like the palms and the feet as they come in contact with hard surfaces. The lower layers below the corneous layer are living. The epidermis does not have any blood in it.

Below the epidermis lies the much thicker part called the dermis. This is richly supplied with blood vessels and nerves. In the deeper parts of the dermis lies stores of fat which not only cushions the body from injuries but also provides an excellent insulation. Scattered in the dermis are numerous structures such as glands and sense organs and appendages, such as hair and nails.

There are two sets of glands in the skin - the sweat glands and the sebaceous glands. The sweat glands separate the water and metabolic wastes from the blood and pass them out as sweat through the sweat pores. The sweat glands are concentrated mainly in the forehead and the armpits. The sebaceous glands have oily secretions that keep the hair waterproof and protect the skin from the drying effects of the atmosphere.

Numerous sense organs of touch, pressure, pain, heat and cold are scattered all over the skin. Nerve fibres originating from them connect them to the brain. Hair and nails are appendages of the skin formed as a result of the outgrowth or thickening of the epidermis. They both grow by the addition of new cells at the bottom of its base.

The skin is really a very useful organ. It serves many purposes like protecting us from injuries and from the invasion of disease causing germs. They also help to remove metabolic waste products through the sweat glands. It is a very essential sense organ as it helps us to adjust to the environment. The skin produces vitamin D with the help of the heat and light of the sun. Vitamin D is important for the growth of the skeletal system. The skin helps in maintaining a constant body temperature by balancing the production of heat with its loss. It also prevents excessive loss of water.

The human skin is creamy white. However, added to it are certain pigments or colouring substances that determine the colour. We get yellow from the yellow pigment and red from the blood circulating in the blood vessels below our skin. The most important pigment is melanin which is dark-brown or black. Sunlight has the ability to create melanin and therefore we see that people living in the tropics have darker skins. Therefore skin colour is mainly determined by the amount of melanin, genetics and the environment.

13. Where do tears come from and why are they salty ?

Our eyes are very important to our well being. However they are very delicate and need great protection from the outside world. For this reason the eyes have been equipped with special lacrimal or tear glands. These glands are situated above the outside corners of each of the eyes. Here the liquid that makes the tears is stored.

The tear gland of the eye

There is always dust present in the atmosphere. To prevent the dust from entering our eyes, the eyelashes continue blinking every now and then. With every blink the eyelids apply suction to the opening of the tear glands and a little of the fluid oozes out across the eyes. This serves two purposes. It keeps the eyes clean from dust as well as lubricates them and prevents them from drying.

Tears contain proteins that are antibacterial and their presence in the eyes removes all bacteria that enter them. Tears are able to absorb oil and mucus present in the eyes. The oil comes from the sebaceous glands that are present along the edge of each eyelid. Every time our lids close, these glands secrete an oil to lubricate the eyelid and lashes. Apart from cleaning and disinfecting the surface of the eyes, tears also supply nutrients to the cornea. The cornea does not have any blood supply. So we see the importance of tears. If there is an inefficient supply of this fluid, as sometimes happens in old people, it results in the painful condition of "dry-eye" and the eye may be damaged.

Tears are carried away from the inside corners of the eyes by little tubes that lead to the back of the nose. However sometimes when something hurts our eyes, the tear glands pour out the fluid

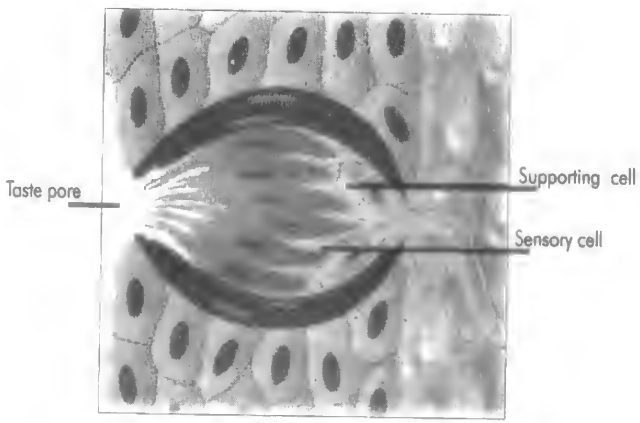
faster than the tubes can carry away to the nose. It is then when the tears come rolling down out of the eyes and down the cheeks. We do all this automatically without our knowledge. It is brought about by an automatic nerve control called a reflex. This reflex helps to protect our eyes.

Tears are also brought about by other reasons. There are times when we feel sad or pain. The reflex action is started by nerve messages that go to the brain. This results in tears flowing. As the tears are drained into the nose we find that the nose tends to run. This is so because there is a larger quantity of tears to be removed and at a faster speed.

When we cry, sometimes a few drops goes to our mouth and we are surprised to note that it is salty. Actually all the fluids in our body are slightly salty This is so because some salts are dissolved in them, one of which is sodium chloride (common salt). Our tears contain about one percent of sodium chloride. Even sweat and urine taste salty.

14. How does our tongue help us to taste our food ?

The tongue is one of the five sense organs of the human body. It is a muscular organ covered with a mucous membrane. In this



Taste bud

are embedded the taste buds. We see these as small little warts on the surface of the tongue. These are called papillae. Each of these consists of sensory cells surrounded by supporting cells. The sensory cells are connected to the sensory neurons which pass messages to the brain. Each taste bud opens out to the surface of the tongue through a small pore.

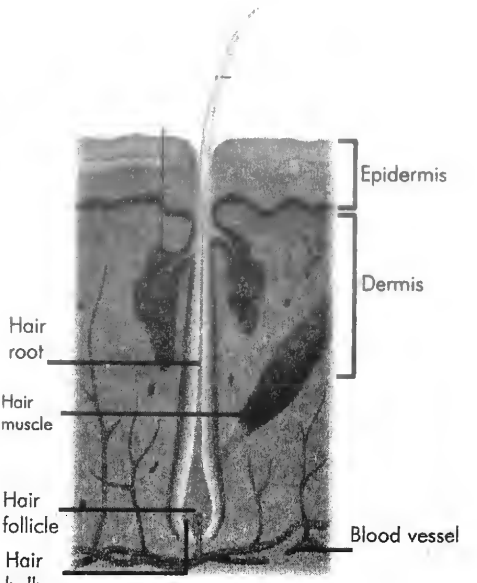
There are different types of taste buds distributed unevenly over the tongue. Thus different parts of the tongue are sensitive to different tastes. The four primary tastes are sweet, sour, salty and bitter. The various other tastes are a blending of these basic sensations. Salt and sweet tastes are detected by the tip of the tongue, sour is felt at sides of the tongue and bitter by the back of the tongue. The centre of the tongue has no taste buds. Food can be tasted only when it is in a liquid state. As the saliva dissolves the food, the taste buds are activated and send messages to the brain.

The taste buds, like all cells are replaced quite often. An adult man has about 3000 taste buds. Children have lesser. As a man grows older, the taste buds decrease in number. An old man has only about 70 of them. That is why old people often complain that the food does not have any taste.

Taste is actually a composite sense of the senses of taste and smell. When we taste things like coffee, cocoa fruits and wine we first smell the aroma of it and then the taste of it reaches our tongue. The nose first sends the message to the brain and after that only do the taste buds react. That is why we see people closing their nose tightly before drinking a bitter or horrible medicine. If the nose is closed tightly one cannot make out the difference.

15. How does our hair grow ?

Hair is an appendage of the skin and is widely distributed all over the body. Each hair grows from a pit called the hair follicle. At the base of the hair follicle is a structure called the hair papilla. This gives rise to the hair by the growth of the epidermal cells covering the papilla. Thus the shaft of the hair grows by the addition of new dead cells from the dermal papilla. Opening into the hair follicles are sebaceous glands. Their oily secretion, sebum, makes the hair waterproof.



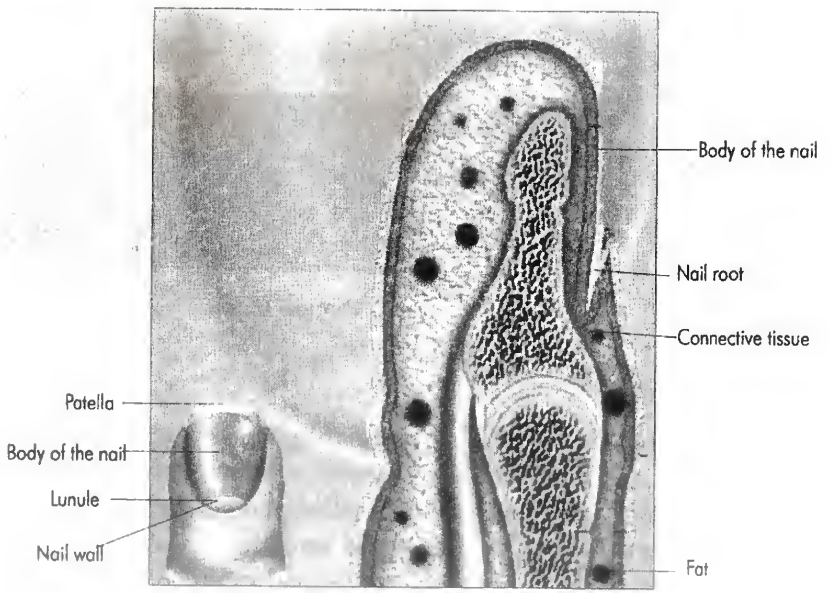
The human hair

The colour of the hair depends on the colour of the pigments as well as on the fine bubbles of air that are present. Melanin is one of the important pigments that colour hair. As a person grows older the production of melanin decreases and this results in the hair growing grey in colour. There are however cases where young people have grey hair. This is due to several reasons one of which is hereditary. Other reasons are shock, worry, malnutrition, tension, severe illness and deep sorrow. These lead to the slowing down of the production of melanin.

A normal adult has about 100, 000 to 200, 000 hairs on the head. It grows about 12 millimetres a month. As each shaft of hair grows to a certain length it falls off as it is unable to get enough nutrition. It is then replaced with a new one from the hair follicle. So the hair you have today is not the same as the one as you had a few years ago.

16. What are our nails made of ?

Nails like hair are appendages of the skin. Nails are formed as a result of the thickening of the epidermal cells, giving them protection. A nail grows by the constant addition of new cells at its base. Nails are made up of a special kind of protein called keratin. Keratin is a dead tough kind of protein. In fact, it is the same keratin which is found in our hair. Nails are present in other animals like the monkeys and apes. The claws of animals like the cat, dog, tiger are also made of keratin. So are the hoofs and the covering of the horns of the cattle.



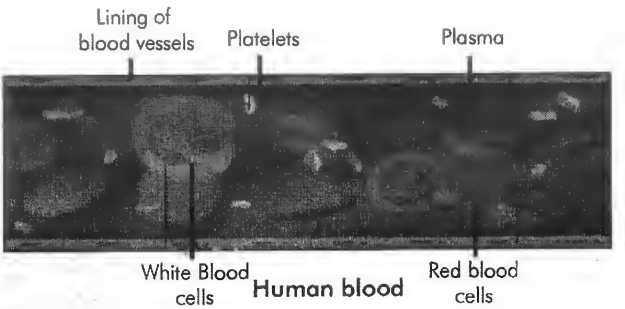
The nail

The base of the nails and the sides are embedded in the skin. The skin below the nails have elastic fibres and these help to keep the nails firmly in place. The nail is thick but at the base it is thin. This part is whitish in colour and is called the lunule This is because it has the shape of a semi circle or half moon. Nails grow at a rate of about 50 millimetres a year.

Nails are very useful to us. They protect the tips of the fingers and toes. They also help us to scratch when we feel itchy. Women take great pains to keep them in a beautiful condition. However it is always better to keep them short and trim as long nails tend to be brittle and chip off easily. Long nails are subject to injury and shock. This leads to infection which sometimes can be very painful. Sometimes infected nails turn black. Sometimes nails grow inward. This can be a very painful condition.

17. Do we have blue blood ?

Yes we do have blue blood. This is found only in certain parts of the body. However to understand this we should first find out how blood gets its colour.



Human blood

Blood is a complex liquid tissue adapted for the transportation of nutrients, respiratory gases, metabolic wastes and other substances. Blood consists of a liquid called plasma and blood cells. Plasma constitutes 55% of the blood and the blood cells 45%. Ninety percent of the plasma consists of water which has organic and inorganic substances dissolved in it. The solids consist of mainly salts, proteins, amino acids, simple sugars and fats.

The blood cells consist of red blood cells, white blood cells and blood platelets. The red blood cells are shaped like flat discs and do not have a nucleus. They have a pigment called haemoglobin, which contains iron and protein. It is this pigment that gives the red colour to the blood. A cubic millimetre of blood

contains about 5 million red blood cells. The haemoglobin is also a respiratory pigment and plays an important role in the transportation of oxygen from the lungs to the tissues of the body. When the red cells get worn out they are destroyed in the liver and the spleen. New cells originate from the red bone marrow. A shortage of these cells lead to a condition known as anaemia.

The white blood cells are larger than the red ones. They have a nucleus but do not have any pigment. In a cubic millimetre of blood there are about only 9000 of these white blood cells. They are shapeless and their function is to protect the body from the invasion of disease producing organisms and destroy them. White blood cells are produced in the bone marrow, lymph and the spleen. Incidentally, even though they are very useful, an overproduction of them leads to leukemia, or cancer of the blood.

Blood platelets are colourless and have no nucleus. They are spherical or irregular in shape and are smaller than the red blood cells. In a cubic millimetre of blood there are about 150, 000 to 400, 000 platelets. When blood vessels are damaged, the platelets initiate the process of clotting.

Now we know that the blood gets its colour from the haemoglobin. However the haemoglobin gets its colour from the amount of oxygen it carries. After passing through the lungs the haemoglobin has a full load of oxygen and is red. This blood is then pumped to the arteries by the heart. When we cut ourselves it is likely to be this red arterial blood that leaks out. The arteries carry this red blood to the capillaries which lead to the cells of the body. There the blood loses its oxygen. The haemoglobin then changes its colour and if it loses almost all of its oxygen, it becomes dark blue. The blood from the capillaries flows to the veins and then back to the heart and then the lungs. So it is the blood in your veins which are blue in colour.

18. What are the different skin problems a person can get?

The skin is the biggest organ in the human body. It serves a variety of functions like protection, excretion, sensory and producing vitamin D. However it is prone to several disorders or problems. Some of them are hereditary, some are naturally formed and some due to our own carelessness.

We may have sometimes seen some people who are albinos. Albinism is a hereditary disease. It is a very rare condition in which the body has no melanin. This is the pigment which gives colour to the skin. As a result of not having melanin, the person's skin and hair are white and the eyes are pink. The eyes and skin are abnormally sensitive to light and the vision is often impaired. Albinism is not restricted to man alone. It is also found in several animals and birds like frogs, snakes, crows, and wolves.

Some people have warts on the skin. Warts are a protuberance composed of a local overgrowth of the skin. The common wart is generally due to a virus infection. It usually disappears within two years or so. These days warts can treated and surgically removed.

Moles are quite commonly found among people and never cause any trouble. A mole is a small, coloured patch of skin where there are a lot extra pigment cells. Most moles are a part of us from the time we are born. If a mole bleeds or grows or changes in size it is better to consult a doctor. If it is a harmless one it can be removed without much trouble.

Freckles are again quite commonly seen on faces of people around you. The pigment melanin that gives colour to the skin is produced in the skin by certain cells known as melanocytes. Freckles are simply a bunching up of these cells instead of being scattered all over. Freckles, too, are hereditary. Sunshine darkens the freckles as more melanin is produced. So if one has freckles it is better to avoid too much of sun.

Sunburn is something quite painful and harmful and we should try to avoid it whenever possible. Light-skinned people generally suffer from it. Sunburn is actually the skin being burned by the ultraviolet rays of the sun. Sunburn causes real damage to

the skin. One of the results of the damage are that the tiny blood vessels just under the skin get enlarged. That allows more blood to flow to the skin and makes that part looking very red and warm. Fortunately the skin regenerates new cells and repairs the affected part. The damaged skin then peels off and is replaced with new skin.

Ultraviolet rays also affect our skin in another way. They make the skin less flexible and wrinkled, making one look older. There are oils in our body that keeps the skin from becoming dry. Too much of sunlight dries up these oils making the skin wrinkled.

As one grows older, the muscles in the skin tend to become weaker and start sagging. The skin develops wrinkles. Generally a person starts getting wrinkles after the age of fifty. There are of course cases where the skin is very dry and scaly even in the youth. This is mainly due to the lack of water in the body. Generally this can be remedied by drinking lots of water throughout the day.

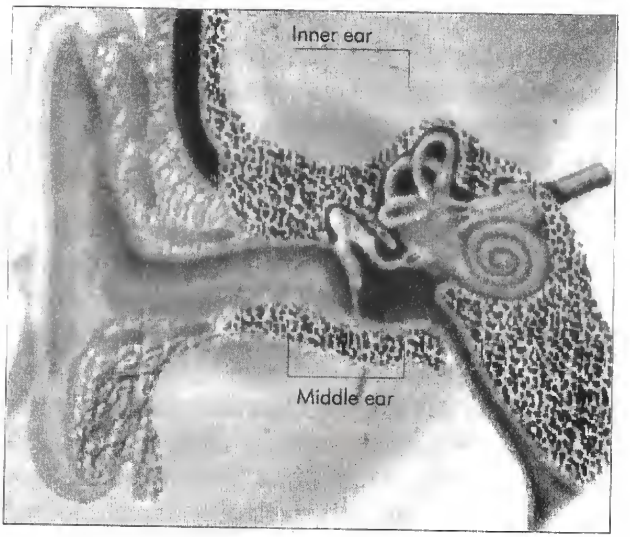
Other skin problems are skin infections caused by fungus or worms. Skin cancer is a very harmful disease. We should take great care of our skin by avoiding too much of strong sunlight and by having a bath daily to keep away the germs.

19. How does the human ear work?

The human ear is a very neat and powerful little organ that helps us to detect sounds as well as maintain our balance. The ear is divided into three main parts in order to help us to understand its working. They are the outer ear, the middle ear and the inner ear.

The outer or external ear consists of the ear lobe or the pinna and the auditory canal. The pinna is supported by flexible cartilage and its function is to collect the sound waves which travel down the auditory canal. This canal ends in a thin membrane called the eardrum or the tympanum. The earwax secreted by certain glands as well as the fine hairs at the entrance of the ear prevent dust and insects from harming the eardrum. That is why we are always

advised not to poke hard and sharp things in our ears. An injured eardrum can result in deafness.



Parts of the ear

The eardrum separates the outer ear from the middle ear. From behind this membrane runs a tube called the Eustachian tube which leads to the throat. The air in this tube helps to equalize the pressure caused by the vibrations on the other side of the tympanum. Present in the middle ear are three little bones called the ear ossicles. They are separately called the malleus (hammer), the incus (anvil) and the stapes (stirrup). When the sound waves strike the eardrum they set these tiny bones vibrating.

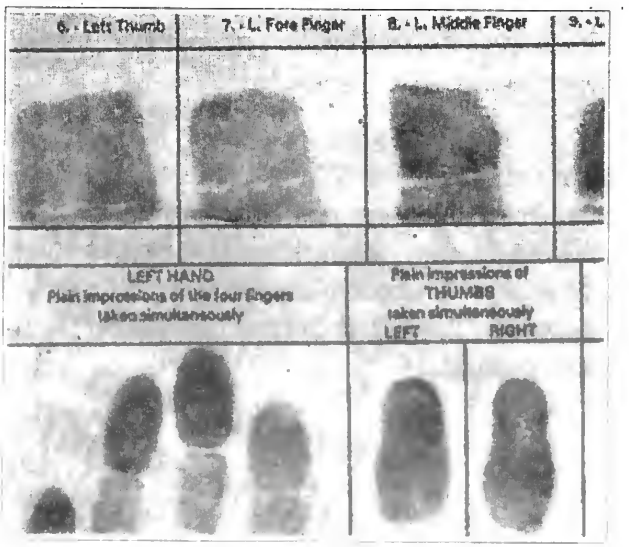
The inner ear consists of a complex set of tubes and sacs. There is a shell shaped tube called the cochlea. The inner ear contains a fluid called the perilymph. The vibrations of the ear ossicles set up vibrations in the fluid. The tiny cells in the cochlea transfer the sound waves to the nerves in the auditory nerve which then pass the message to the brain. The brain understands the sounds. Thus we are able to hear and understand sounds.

There are three semicircular canals in the inner ear. These contain a fluid which help the body to maintain a balance. If there

is any problem with them then the person becomes dizzy and loses his balance. Some people are born deaf while others become deaf or suffer hearing problems due to certain reasons. Sometimes severe infections or diseases cause damage to the ear. Severe colds, mumps, measles, tonsillitis and meningitis can cause poor hearing. Sometimes very loud and violent sounds can affect the hearing system. After the age of fifty the hearing mechanism gets slowly impaired.

20. Will the fingerprints change after the fingers are injured ?

You might have noticed your fingerprints left on a dirty glass window or table. There are clear line patterns. In fact each finger has a different pattern. These are your special fingerprints. There are a network of ridges on the tips of our fingers. These are actually the "touch" receptors of the skin. The ridges enlarge the area of the skin on the fingertips so that there are more nerve endings there than if the skin was smooth. For this reason the finger tips are very delicate and are very sensitive to touch.



Finger prints

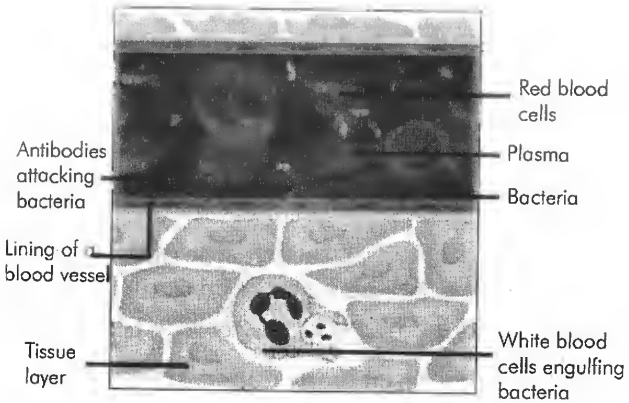
The pattern of the ridges are different for every person. Your pattern is constant throughout your life. Even if you injure your fingers or burn them the same pattern will emerge after the fingers are healed. Not just human beings have fingerprints. Even our closest animal relatives, the apes have them.

The fingerprints of each person is different. In fact, the ridge pattern on each of our fingers are different. There are the same type of characteristics in everyone's pattern, but each are arranged differently. A fingerprint expert can distinguish these slight differences very easily. The police departments all over the world have these experts to catch criminals. How is this done? Whenever we touch anything we leave a trace of sweat from the sweat glands on the finger tips. This leaves our fingerprints on the touched surface. When a crime is committed, the fingerprint expert searches for possible things that the criminal might have touched. He then dusts aluminium powder on that area to make the fingerprint show up clearly. He studies these prints and matches them with his collection of fingerprints. However the prints should match in 16 different ways before they can be used as evidence in a criminal case.

In most countries a list of the fingerprints of convicted criminals are always stored by the police in order to refer to them later and when required. In several places fingerprints are used on identification papers. It is interesting to note that fingerprinting was used as a means of identifying criminals in India. It was later adopted by the British police and used for the first time in 1901 to solve a crime.

21. How does the body build up immunity?

The human body is one of the most wonderful and complex creations. It is however constantly under attack from foreign invading microorganisms. Fortunately our bodies are equipped well for protection with a very efficient immune system and this provides us immunity. By immunity, we mean, the body's ability to defend itself against infection and disease.



Immunity

When "foreign" bodies invade your body, such as bacteria, viruses, fungi or pollen grains, the immune system recognizes them as dangerous. They immediately react by making antibodies which render them harmless. Once antibodies against a particular disease have been formed the body can continue producing them again and again. The body can then become immune to that infection. This type of active immunity can last for a long time.

There is another type of immunity called passive immunity. This happens when antibodies from a person who is immune is injected into you. For example babies get passive immunity as antibodies pass to them through their mothers. This is however not very long-lasting.

The parts that make up our immune system are the leucocytes

(white blood cells), thymus, spleen, lymph nodes and the tonsils. The leucocytes, or the white blood cells, play a major role in building immunity. They engulf the invading organisms and other unwanted material. White blood cells are produced in the bone marrow. Macrophages are a type of white blood cells that specialize in removal of bacteria and the debris of cells after injury. They are found mainly in the lymph and connective tissues and especially in the lungs. Here they ingest dust, fibres and other inhaled particles. Lymphocytes are also a type of white blood cells and are commonly found in the blood, lymph and in the sites of infection.

The lymph nodes are small round bodies chiefly situated in the neck, armpit, groin, abdomen and thorax. The lymph nodes filter out the harmful bacteria.

The spleen is situated on the left side of the body, behind the stomach. It processes lymphocytes. It also regulates the amount of red blood cells in the blood by destroying the old cells.

The thymus is situated in the upper chest cavity. It processes lymphocyte cells to produce T lymphocytes (T denotes thymus derived)which kill invading organisms or render them harmless. Thymus reaches its full size at puberty and shrinks thereafter. Their function diminishes in adults but it continues to function as an endocrine gland.

The tonsils contain lymphocytes and are also part of the body's immune system. They are situated at the back of the throat and give protection against infection.

Immunity is also provided by other things like the skin, the tear fluid, hydrochloric acid in the stomach and mucus in the respiratory airways. The body does its best to protect itself from the ravages of disease. Sometimes it is a losing battle. These days AIDS is one of the many viral diseases that affect the immune system itself.

INTERESTING INFORMATION

The smallest bones in the human body are the three ossicles in the middle ear. The heaviest is the hip bone or the pelvic girdle.

Blood makes up 5% of the body weight. An adult man has about 5 litres of blood in his body.

There are about 6 million red blood corpuscles in every millilitre of blood of an average adult human being.

Red blood corpuscles die at the rate of 200 billion per day. The body produces new cells at the rate of 9000 million per hour.

The human heart contracts and expands about 100, 000 times a day and pumps about 13, 630 litres of blood in 24 hours in an adult male.

The brain of an adult man weighs about 1. 4 kg. An earthworm's brain is the size of a pinhead and a rabbit has a thimble sized brain. However size does not determine the intelligence. Elephants have a much bigger brain than a man but it is not as intelligent or developed.

The cerebrum, the largest section of the brain, looks like a huge shriveled up walnut. Research seems to reveal that the mental capacity of a man is related to the number of ridges and furrows in it. The higher the intelligence the more numerous and deeper the folds.

Nerve impulses travel quickly in humans. They may reach speeds of 160m per second.

The retina in the eye contains about 137 million light sensitive cells in an area of about 650 sq. mm.

The focussing muscles of the eyes adjust about 100, 000 times in a day. To exercise the leg muscles to the same extent would be like taking an 80 km walk.

The human eyes have only 3 colour pigments - red, blue and green. The mantis shrimp's eyes contain 10 colour pigments with

which to perceive colour. Some flies and fishes have 5 of them.

Onions contain a chemical called "1 propenyl sulfonic acid". It is a lacrimator and this is what brings tears to our eyes when we cut onions.

Man is not the most sensitive taster. Man has 3000 taste buds A pig has 5500 taste buds, a cow has 3500 and an antelope has 50, 000. On the other hand, a whale has few or none at all.

Water is the major substance in our body. About 70% of the body is water.

Colour blindness is more common in men than in women In men the incidence of colour blindness is 8%. On the other hand it is only 0. 5% among women.

The femur bone, or the thigh bone, is the longest bone in the body. It is about 27 ½ percent of a man's stature.

The hardest substance in the human body is the tooth enamel

There are more than 100 types of cancer which affect man. Cancer is by no means a modern disease. Research has revealed that it was present even during the ancient Egyptian civilization. Evidences of this disease have been found in the Egyptian mummies.

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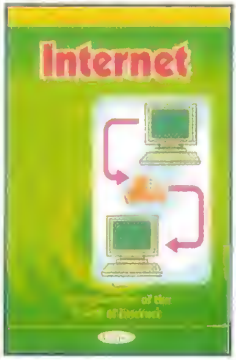
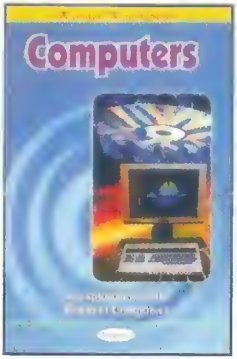
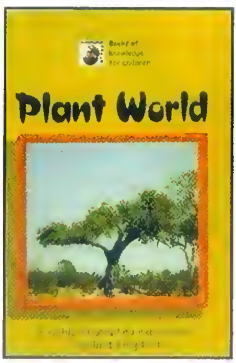
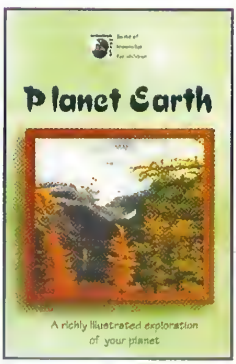
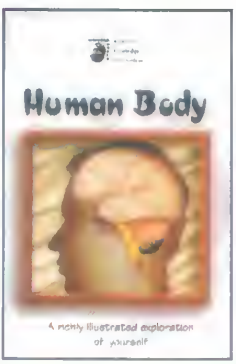
Titles available in this series











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